the other three ; but those who are interested in this subject will have to study the series of memoirs on " Les Races de l'Europe," by Dr. Deniker, of which the first instalment on the cephalic index has been published by l'Association Française pour l'Avancement des Sciences (26ᵉ Session, 1897), 1899. In the volume under review there are, owing to the necessary limits of space, insufficient data to profitably discuss the author's position. It is evident that Dr. Deniker has published the conclusions which he has already arrived at from a study of the large amount of facts he has accumulated, and of which one valuable section has alone yet been published. Unfortunately, many anthropological terms are insufficiently fixed, and all authors are not careful to promote uniformity of definition—the term "race" is a case in point—and our author admits of more races in Europe than do other anthropologists ; indeed, in his treatment of European ethnography he is more analytic than synthetic.

It is always easy to criticise ; especially does a book like this lend itself to captious reviewing ; but it is not every one who could write so sound and clear a summary of the scattered information that has been accumulated on an intricate subject.   A. C. HADDON.

SYSTEMATIC BACTERIOLOGY.

System der Bakterien. Von Dr. W. Migula. Zweiter Band, Specielle Systematik der Bakterien. Pp. x + 1068 + xviii Plates. (Jena : Gustav Fischer, 1900.)

THIS volume is the second part of a work, of which the first part was reviewed in this journal in June 1898. It was then pointed out how meritorious was this undertaking of Prof. Migula, well known by his researches into the morphology of bacteria and allied organisms, in attempting to scientifically group the enormous number of forms of bacteria that had been discovered and described. No better index for the great difficulties of classifying bacteria in a scientific manner need be adduced than the fact that bacteriology within the last fifteen or twenty years has advanced by leaps and bounds, and that a host of workers—botanists, chemists, and last, but not least, pathologists—have been busy in discovering new forms, and describing and classifying them in any but a scientific manner, and on principles widely differing according to the actual point of view of the individual observers.

To classify and systematise on scientific principles, such as obtain in other departments of natural history, is a task which demands an enormous amount of labour and a comprehensive knowledge, which few observers would be willing to spare or able to command. Prof. Migula is to be congratulated on having, with his thorough grasp of this new and ever-widening field of research, and with a truly prodigious industry, achieved this result in as thorough a manner as can be expected in a branch of natural history so new and so growing as systematic bacteriology.

It will be remembered that in the first volume bacteria were considered in a general way as to their morphology and activity, and by these studies the endless number of

bacterial species received their proper and scientific allocation. Thus the bacteria, as a "class," were arranged in two great groups or "orders," viz. : (1) Eubacteria, free of sulfurgranules and bacteriopurpurin, and (2) Thiobacteria, including sulfurgranules, and their protoplasm either colourless or coloured by bacteriopurpurin (pink, red or violet).

The "order" of Eubacteria comprises four "families" : (*a*) Coccaceæ, cells spherical ; (*b*) Bacteriaceæ, cells rod-shaped or cylindrical ; (*c*) Spirillaceæ, cells more or less curved and spiral ; (*d*) Chlamydobacteriaceæ, cells cylindrical, arranged in threads surrounded by a common sheath.

The first family, Coccaceæ, comprises five "genera," viz. : genus 1, Streptococcus or Chaincocci; genus 2, Micrococcus ; genus 3, Sarcina ; genus 4, Planococcus ; genus 5, Planosarcina.

Genus Streptococcus comprises 50 different known species; genus Micrococcus comprises 228 ; genus Sarcina comprises 55 ; genus Planococcus, 7 ; and genus Planosarcina three distinct known species.

The second family, Bacteriaceæ, is divided into three genera, viz. : genus 1, Bacterium, without flagella, comprising 302 different species ; genus 2, Bacillus, flagella more or less over the whole body, comprising 452 species ; and genus 3, Pseudomonas, flagella only at the ends, comprising 79 different species.

The third family, Spirillaceæ, is divided into four genera, viz. : genus 1, Spirosoma, with 7 species ; genus 2, Microspira, with 68 ; genus 3, Spirilla, with 16 ; and genus 4, Spirochæta, with five different species. These three families are minutely dealt with in 1030 pages ; the whole of the fourth family of Chlamydobacteriaceæ, with its four genera and nine species, and the whole of the second "order" of Thiobacteria, with its two families (five genera), and comprising twelve species, altogether receive only twenty pages, so that practically the volume is devoted to a description of Coccaceæ, Bacteriaceæ and Spirillaceæ.

In looking over the description of the 1272 species belonging to these three families, and while admiring the prodigious labour, one cannot help sympathising with the author in the difficulties to determine which is, and which is not, a true species ; which is, or is not, merely a variety ; so much so that it seems as if in distinguishing "species" from "varieties," and *vice versa*, a certain arbitrary plan had to be followed. For, in some instances, the distinction between one "true" species and another is based chiefly on very slight cultural differences in one or the other artificial medium ; in others on minute details of artificial staining, or on slight differences in size on one or the other artificial mediums ; or even slight shades of natural colouring on a particular medium, or slight differences in physiological action. That is to say, numerous instances occur where one or the other of these points is used for distinguishing one species from another, and other equally conspicuous instances occur where these differences only suffice to mark off a "variety." One example will suffice to illustrate this difficulty. In the genus Streptococcus, the first species dealt with is that of "Streptococcus pyogenes" of Rosenbach ; to this "species" the author assigns as

"varieties" the Streptococcus erysipelatos, the Strepto-coccus conglomeratus (Streptoc. scarlatinæ), the Strepto-coccus brevis and longus, Streptococcus murisepticus, and Streptococcus septo-pyæmicus. According to the author, the differences in size, arrangement, cultural characters and physiological action of these "varieties" and the "Streptococcus pyogenes" are slight, and do not justify a separation as true species. Now, any one who has had sufficient experience in the matter of these so-called "varieties" must know that the cultural and physiological differences between these "varieties" and the "species" are sufficiently definite and conspicuous ; in fact, quite as definite as those described of several others of the author's true "species" of Streptococcus.

The same difficulty is met with in looking over some of the species of the genus Micrococcus, Bacterium and Bacillus. As mentioned above, the chief distinction be-tween genus Bacterium and Bacillus is the absence or presence of flagella ; now looking through the description of some of the species belonging to "Bacterium," we find several in which the absence of flagella is deduced apparently solely from the fact that in the fresh state (hanging drop) no mobility is observed ; but this, as is well known, is deceptive for a true diagnosis, and no safe reliance can be placed on it. In the same way we find some species of "bacillus," e.g. bacillus pestis, as being surrounded by flagella. I have no doubt this statement will come to many as a surprise, and one would like to know whether this bacillus pestis of Migula had been tested on animals and had caused the typical disease.

The volume contains at the end eighteen plates, each with eight figures of clear and good prints of photo-graphic representations of many species of Coccaceæ, Bacteriaceæ and Spirillaceæ. Many of the figures are excellent, e.g. those of Flagellate bacilli, Pseudomonas and Spirillaceæ ; some others might without disadvantage have been omitted as not representative or too little representative ; e.g. there occur five figures of *Vibrio cholerae asiaticae* [Microspira Comma (Migula)], not one of which is really characteristic of the microbe.

The important points of the formation, appearance and distributions of spores in many bacillary species, is repre-sented by a single figure (Fig. 2, Plate iv.) showing dots in anthrax threads supposed to have been photographed at a magnification of 1000 (!).

The book on the whole must occupy an important place not only as a thoroughly systematic work, but also as a book of reference, there being attached to each species a valuable paragraph of bibliography.

E. KLEIN.

COLLECTED WORKS OF L. LORENZ.

Ouvres Scientifiques de L. Lorenz. Revues et Annotées. Par H. Valentiner. Tome Premier, Deuxième Fas-cicule ; Tome Sécond, Premier Fascicule. Pp. 213+529 and 315. (Copenhague : Lehmann and Stage, 1898 and 1899.)

THE custom of collecting into convenient form the works of a distinguished writer has much to recom-mend it. We in England have realised its importance, and we gladly welcome this edition of the collected works

of Prof. L. Lorenz, two parts of which are now before us, published in French, at Copenhagen, under the editorship of Dr. H. Valentiner, and at the cost of the Carlsberg Foundation. The two volumes cover a wide period of time ; the first paper, that containing Prof. Lorenz's theoretical and experimental researches on indices of refraction, was printed in 1869. The author's name is well known as one who has worked at optical theory, and has carried out experiments of great importance with a view to the verification of crucial points in that theory. The phenomena of dispersion, and the relations between the optical properties and the physical conditions of a substance, offer a fascinating field of research ; and it is of real service to have here, in accessible form, the elaborate series of papers which led Lorenz to the conclusion that the quantity $(\mu^2 - 1)/(\mu^2 + 2)\rho$ was a constant for the various states of a refracting medium. This is hardly the place to discuss at length the various steps that lead the author to that conclusion. In Lorenz's view the ether inside a transparent medium, such as glass or water, cannot be treated as homogeneous. His solution of the problem is most easily followed in the paper, "Ueber die Refractions Constante" (*Wied. Ann.* tome xi.), the mathematical de-velopments of which are given on p. 360 of the first volume now under consideration. Lorenz assumes, in this paper, that within the molecules of a transparent body the velocity of light is constant, and in the inter-spaces between the molecules it is also constant ; the actually observed velocity will depend on these two constants. In the paper now before us it is assumed further, though this is shown not to be vital to the result, that the molecules are spheres. The problem thus discussed is that of the transmission of light through a complex medium consisting of trans-parent spheres embedded in a homogeneous medium, and with these assumptions it is shown that the quantity $(\mu_\infty^2 - 1)/(\mu_\infty^2 + 2)$ is proportional to the mass per unit volume of the compound medium. In obtain-ing the above equation, the effects of dispersion are neglected ; a later paper (*Wied. Ann.* tome xx.) dis-cusses these on the assumptions (1) that the density of the ether near any molecule is a function of the distance from the centre of the molecule, so that the ether is arranged round each molecule in spherical layers, which change in density on passing from one layer to the next ; and (2) that Fresnel's sine and tangent formulæ hold for each such transition.

From this Lorenz obtains the equation

$$(\mu^2 - \mu_\infty^2)/(\mu^2 + 2\mu_\infty^2)\rho = a/\lambda^2 + b/\lambda^4 + \ \cdots$$

μ being the refractive index for waves of length λ, and μ_∞ that for infinite waves.

Other papers in the volume before us are concerned with experimental investigations into the truth of these formulæ. As a result of one series of experiments, it appears probable (p. 245) that the refractive index of water is a function of the density of the water, and not of the temperature, except so far as that produces change of density ; while, in general, Lorenz concludes that for a number of gases and vapours the equation

$$(\mu_\infty^2 - 1)/(\mu_\infty^2 + 2)\rho = a \text{ constant}$$

is satisfied with considerable accuracy.